Titration of Vinegar by NaOH

Assessment Limit : DCP/CE

Introduction:

A titration is a technique often used to find the concentration of a solute in a solution. In this lab we will be finding out the concentration (molarity) of the acetic acid in vinegar and also the percent of acetic acid in vinegar.

Objectives:

- To learn how to use a buret to perform a titration
- To be able to calculate the concentration of an unknown acid or base in solution
- To be able to calculate the percent of a substance in solution.

Background:

The odor of vinegar is due to the presence of acetic acid. Vinegar is made by the action of microorganisms on certain carbohydrates. This fermentation process is really a series of steps that results in what we call vinegar. Since vinegar can be made from anything with sugar, there are probably too many different types to count made in countries throughout the world. Each country may use starting materials native to their area and tailored to the specific tastes of the region.

Typical retail varieties of vinegar include white distilled, cider, wine (white and red), rice, balsamic, malt and sugar cane. Other, more specialized types include banana, pineapple, raspberry, flavored and seasoned (e.g., garlic, tarragon).

In addition to acetic acid vinegar contains many additional compounds including vitamins such as vitamin B-1. The flavor of vinegar is due to the starting materials used.

Safety Goggles and Apron are to be worn at ALL times. NO open-toes shoes are allowed.

Procedures:

PART I:

Standardizing the NaOH solution

The NaOH solution must be standardized because sodium hydroxide as a solid tends to pick up a great deal of water from the atmosphere (deliquescent), and secondly the water may contain dissolved carbon dioxide which causes the molarity to deviate from the calculated value. [Remember the molarity of a solution is equal to the number of moles of solute divided by the volume of the solution. Because the NaOH can pick up water from the air (and may be impure in solid form) and the water may contain dissolved carbon dioxide we MUST always standardize the NaOH solution before using in order to assure accuracy of our calculations.]

1st Obtain, in a clean 250mL earlenmeyer, transfer 15-20 mL of 6M NaOH by volumetric pipet. Dilute with DI water to 250mL (precision not needed). Stir (swirl) the solution well. Label with "NaOH, *names*, period." This solution cannot be contaminated, wasted, or the lab must be repeated. Once this solution is made you cannot add any water, sodium hydroxide, or other material. This is now your solution!

2nd In a second 250mL earlenmeyer, add a measured amount (between 0.80 and 1.20 grams) of potassium hydrogen phthalate ($KHC_8H_4O_4$), abbreviated KHP. Dilute with 50 mL of DI water and add 2-3 drops of indicator. (You will do 2-3 trials of this)

3rd Rinse out the buret two or three times with DI water (just the first time). Drain the water into a waste beaker or down the drain.

4TH Now you are ready to fill the buret with your NaOH to be standardized. Rinse the buret with 5-10 mL of your base. Then fill the buret with base until it is close to (but below) the 0.00 mL line. Remove funnel before titration and measurement.

5th Obtain a piece of white paper to help with your visual acuity. Place the piece of white paper below the behind the buret so that the volume can be read more accurately.

6th Place the acid flask under the tip of the buret, and very slowly (dropwise, not stream) titrate to the endpoint. The endpoint (where the hydroxide ion from the base and hydrogen ion from the acid are completely used up) is when the indicator (phenolphthalein) turns a very light pink color. If very pink, you went too far. The last bit should be added about one drop every 10-15 seconds. SLOWLY!!!

7th Calculate the Molarity of the trial.

8th Repeat this process for a total of three trials that have a calculated molarity that agree with one another to a reasonable degree of precision.

Part II:

Titrating the Vinegar ($HC_2H_3O_2$) Solution

1st The buret will again be holding the NaOH. Same procedures as before with regards to this.

2nd Transfer 10.0 mL (if you're low on NaOH you may use 5.0 mL) of commercial vinegar into your empty acid flask (previously containing the HCl solution) by volumetric pipet. Record a precise value. Dilute to 50mL (not precise) and add 2-3 drops of indicator as before.

3rd Titrate to the endpoint as in part I. The color will be the same. Very dilute pink color. The color should persist for 30-60 seconds, and then fade. *If you overshoot (first let the teacher know then add 1.0 mL of commercial vinegar using a pipette as before, and re-titrate until the endpoint.)*

4th Repeat steps 1-3 two more times so that you have a total of three **GOOD** trials. You may begin calculations at this point

5th Save the left over NaOH in the flask until I have seen the results. If results are approved by the teacher then the remainder of the NaOH solution can be disposed of down the drain. Rinse out the flask and return to the cart.

6th Rinse the buret with copious amounts of DI water. Leave filled with water.

Assessment Limit: Produce your own data table, calculations, conclusion, etc. IB and ECA assessments are 10/11 (DCP/CE)